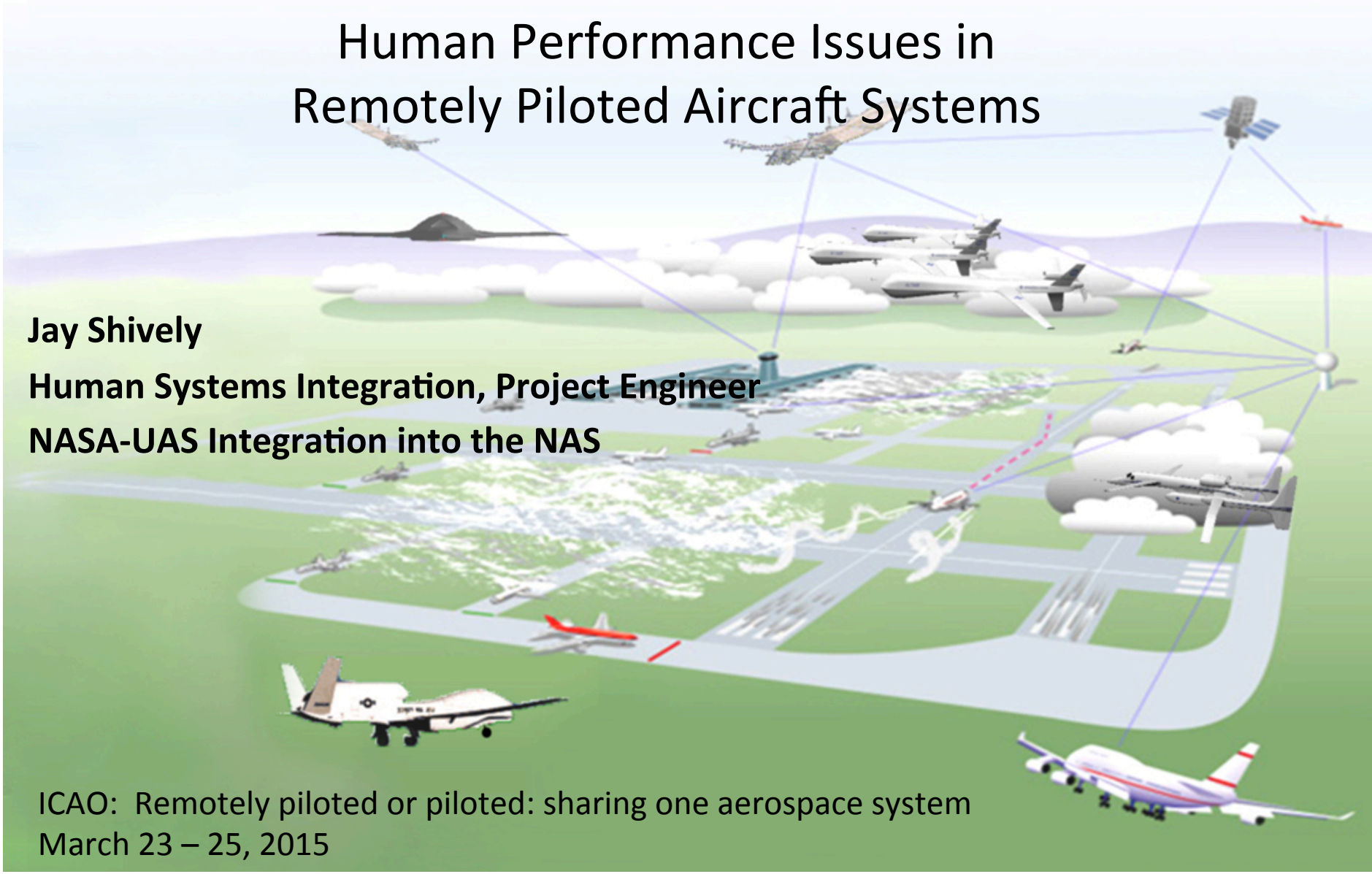
Human Performance Issues in Remotely Piloted Aircraft Systems



Jay Shively

Human Systems Integration, Project Engineer

NASA-UAS Integration into the NAS

ICAO: Remotely piloted or piloted: sharing one aerospace system
March 23 – 25, 2015

Legacy from Manned Aviation

- Good
  - Safety
  - Professionalism

- Bad
  - Slow, reactive regulatory process
  - Flying “economy”
  - High entry price

- Ugly
  - High Human Error rates !!

Human Performance In RPAS

Aviation accident stats

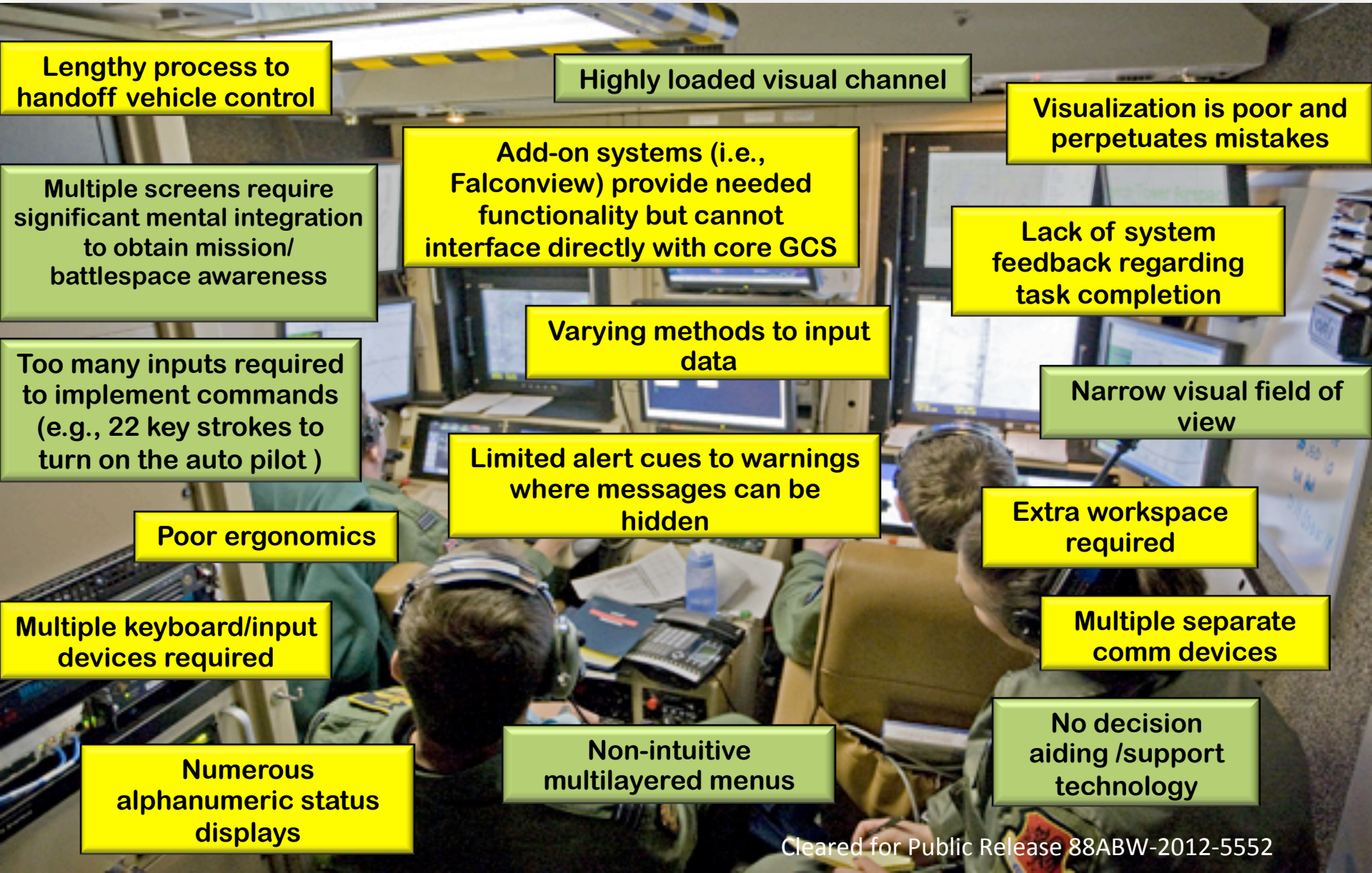
- Although percentages vary, most would agree that somewhere between 60-80% of aviation accidents are due, at least in part, to human error (Shappell & Wiegmann, 1996).

RPAS accident stats

- About 100 Predator Accidents from 1997 – 2005 ; 51% mishaps involving crewmember acts (Tvaryanas, 2005)
- Tvaryanas (2004) on mishap epidemiology states that Human System Interface (HSI) issues are discussed in 89% of the Predator accidents and are cited as a causal factor in 44% of those accidents.
- Mishaps in the first few years were often attributed to equipment failures, while mishaps in the last three years were predominantly operator error (Nullmyer, et al, 2007)
- As drone use has taken off, human error remains a leading cause of unmanned aerial vehicle crashes. (Popular Science, 2013).

- Why ? How can we do better ?

Current UAV Operator Interface Issues



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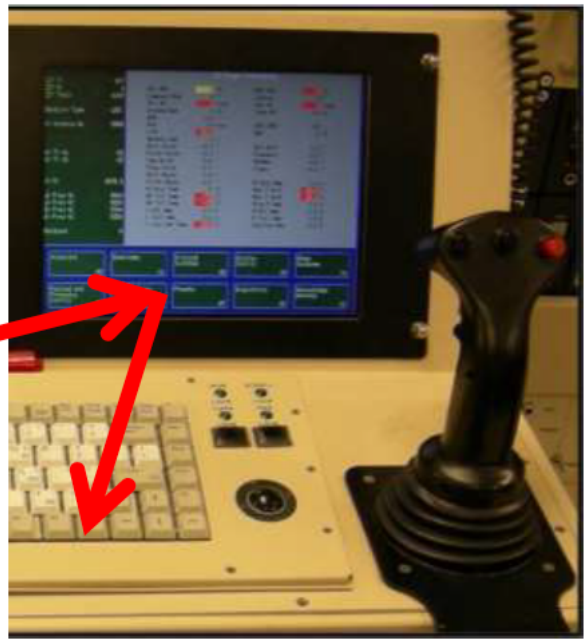
Example

Q: How do I TURN **ON** the Fuel Heaters?

Fuel Heat Inhibit

Disable / Enable



A: Disable the Inhibit…
A double-negative!

Courtesy of Former NASA UAS Pilot

UAS?

Well….What if you stepped into your cockpit…

…and you lost 4 of your 5 senses?

You **only** have *vision!*

How can we replace the information ?

- You ***can't hear*** the engine rpm fluctuating
- You ***can't feel*** vibrations, accelerations or motion
- You ***can't smell*** the fuel leak
- You ***can't taste*** the electrical fire smoke
- AND, you ***lose vision*** in one eye, 30º FOV!
- WELCOME to UAS flying!

Is it Pilot Error ?

A little background:

- April 26, 2006 (NTSB, 2006)
- Predator B with two side-by-side consoles
- Power lever operates in two modes
  - Sensor – controls Iris, middle position locks
  - Pilot – engine control, middle position shuts off fuel

Events:

- Pilot's console "locked-up"
- Pilot took over sensor console
- Did NOT perform transfer checklist
- Power lever was in middle position (now fuel shut off)
- Warning tone (but all the same;

thought to be temp lost link)

- 3:50 a.m., A/C impacts the ground near Nogales, AZ

UAS Pilot Quotes

"This thing's kind of climbing like a pig. Climb, you pig. . . . Boy, this is going to be tight. . . . Okay, interesting. We are falling out of the sky."

Unidentified pilot of a Predator that crashed near Creech Air Force Base in Nevada on May 13, 2013.

"Drone just pitched up. Drone's pitching over. Drone is uh, crashed and destructed, at uh, the end of the runway."

Unidentified pilot of a chase plane that was following a QF-4E target drone before it crashed at Tyndall Air Force Base in Florida on July 17, 2013.

"We're in the soup here. . . . Dude, uh, we're not sure what the aircraft is doing. . . . Yeah, we crashed."

Unidentified pilot of an Air Force Reaper as it crashed in Douglas County, Nev., on Dec. 5, 2012.

"Whoa. . . . I don't know what the hell just happened."

"Where the hell is — where is the runway? It's all the way over here. I overshot. Oh, shit. I think we lost the engine. Oh, shit, oh damn, oh my God, what is that? . . . What was all that stuff I just hit?"

Air Force Capt. Matthew Scardaci as his Predator crashed into a row of empty shipping containers at Kandahar Air Base on May 5, 2011.

"I couldn't tell which way it was turning, or if it was straight, if it was upside down, or if it was right-side up. . . . I couldn't grasp what was happening with the aircraft. And he said he thought it was upside down."

Unidentified Predator pilot to investigators trying to determine how and why she flew the drone upside down before it crashed near Kandahar Air Base on Jan. 15, 2010.

"Um, I guess I'll just be blunt and say not well."

The Predator pilot who flew upside down, when asked by investigators how well her training had prepared her for such an incident.

A VERY Partial List of Issues

- Pilot selection/ certification/ training
- GCS database compatibility
- Lack of GCS Standards
- Pre-flight planning
- Lack of sensory cues
- GCS Human Factors Best Practices
- Clumsy automation
- Detect and Avoid
- Well Clear
- Collision Avoidance
- Lost Link
- Visual clearances
- Surface operations

Example: The "T" arrangement
It works in many types, small and large.

Cessna 182 Boeing 737

How can the industry reduce human performance errors ?

- Introduce Human Factors early on – in a “human-centered” design process
- Design to let people perform the tasks where they are superior
  - Novel conditions
  - Pattern recognition
  - Decision making
- Let Computers do what they are good at
  - Number crunching
  - Vigilance
  - Integrating diverse sources and large amounts of information
- Don’t automate with “leftover” principle
- Design robust, flexible automation that is mission/scenario driven

A Few Current Efforts

- NASA – UAS Integration into the NAS
  - Human Systems
    - Displays, alerts, GCS
  - Communications
  - Detect and Avoid
- DoD
  - AFRL – Airborne Sense and Avoid
  - Army – Ground Based Sense and Avoid
- FAA Technical Center
  - Minimum Information displays